

D.) AMENDMENTS TO THE DRAWINGS

NONE

E.) REMARKS/ARGUMENTS

This Response is filed in response to a Final Office Action dated April 11, 2007.

Upon entry of this response, claims 1-20 will be pending in the Application, claims 1-11 are withdrawn and claims 12-20 stand rejected.

In the outstanding Office Action, the Examiner objects to claims 13-16 and 18-20 for informalities and rejected claims 17 and 18 under 35 U.S.C. 103 as obvious over Steibel et al. 6,280,550 in view of JP-6-137103 and the admitted prior art, and rejected claims 12-20 under 35 U.S.C. 103(a) as being unpatentable over Steibel et al. 6,280,550 in view of JP 6-137103, the admitted prior art and Steibel et al. 6,258,737.

Response to Argument

The Examiner stated in the Response to Arguments section of the pending rejection that "Insert performs used in the thick dovetail section of turbine blades is known as taught by the admitted prior art. The references in combination suggest that it would have been obvious to one of ordinary skill in the art to have provided the composite turbine blade of Steibel not only with a dovetail section and but to also have provided insert performs in this dovetail section. The Examiner's position is that one of ordinary skill in the art would have been motivated to use the same type of insert performs in the dovetail section as those used in the blade section of Steibel et al."

The Applicant argues that the Examiner's position is not supported by the prior art, including the purported admission of prior art. In particular, the Examiner's statement that "The Examiner's position is that one of ordinary skill in the art would have been motivated to use the same type of insert performs in the dovetail section as those used in the blade section of Steibel et al." is an unsupported assertion that goes to the heart of Applicant's invention that is nothing less than hindsight reconstruction. The Examiner has provided no motivation for making this modification to the prior art as provided for under the Graham v. Deere test, nor has the Examiner provided any supporting statements as to this motivation.

Additionally, as is well known in the art, the properties and conditions under which the airfoil having the inserts of Steibel et al. would operate requiring material characteristics such as stiffness would not be similar to the properties and conditions desirable in the dovetail section, in particular, strength. The substitution of the type of inserts thus not being motivated by any similar operationally desired characteristics.

Furthermore, Applicants statement found on page 6, lines 5-6 that "These techniques include the use of insert plies and preform inserts in the dovetail section to build up thickness." in the BACKGROUND OF THE INVENTION section does not cure the lack of motivation. Applicant does admit that preform inserts as taught in the prior art have been used in dovetail sections. This does not mean that preform inserts as claimed and disclosed in the present invention are known in the prior art. The prior art perform inserts are exemplified by the titanium or stainless steel wedges as found in U.S. Patent No. 4,040,770 and the wedge-shaped metallic inserts of U.S. Patent No. 3,752,600.

In contrast, independent claims 12 and 17 include the limitation for a core insert section comprising "a material selected from the group consisting of silicon carbide-silicon carbide composite preform having at least some porosity, silicon-silicon carbide composite, silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic" which is not taught or obvious in light of the prior art.

Thus, the Examiner's statement that " The Examiner's position is that one of ordinary skill in the art would have been motivated to use the same type of insert performs in the dovetail section as those used in the blade section of Steibel et al." is unsupported.

As set forth in MPEP §2141, the references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention. Furthermore, MPEP 2141 states that when applying 35 U.S.C. 103, the following tenets of patent law must be adhered to:

- (A) The claimed invention must be considered as a whole;
- (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination;
- (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and

(D) Reasonable expectation of success is the standard with which obviousness is determined.

Hodosh v. Block Drug Co., Inc., 786 F.2d 1136, 1143 n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986).

In Summary, the references and Applicant's alleged admission of prior art do not teach or suggest the modification to Steibel '550 that arrives at Applicant's invention of a core insert section having the claimed composition limitations in the dovetail section of the turbine blade form.

Additionally, Applicant provides further discussion as to why the requirements for forming a rejection under 35 U.S.C. 103 have not been met by the Examiner under further grounds, and why the claims are allowable over the cited prior art, in the individual rebuttals to the rejections as found hereinafter.

Claim Objections

The Examiner objected to claims 13-16 and 18-20 for lack of consistency with the independent claims from which they depend.

In these claims, the Examiner found that the phrase "silicon-silicon carbide preform" of claims 12-16 and 18-20 not to be consistent with "silicon-silicon carbide composite perform" as found in claims 12 and 17. The Applicant has amended claim 12-16 and 18-20 to correct this informality.

Applicant submits that no new matter has been added as a result of these amendments to these claims.

Rejections under 35 U.S.C 103

A. Steibel 6,280,550 in view of JP 6-137103 and the admitted prior art.

The Examiner has rejected claims 17 and 18 under 35 U.S.C. 103(a) and being obvious over Steibel et al. 6,280,550, hereinafter referred to as "Steibel '550" in view of JP 137103 and the admitted prior art.

Specifically, the Examiner stated that:

"Steibel et al. 6,280,550 discloses a method of making a composite turbine blade comprising: providing first reinforcement comprising an insert preform of silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite preform having porosity); optionally depositing matrix material to fill only a portion of the porosity of the insert preform (silicon-silicon carbide composite preform having some porosity); providing second reinforcement comprising silicon carbide fabric plies preform); applying the silicon carbide fabric plies to contact the insert and define the surface shape of the blade; and depositing matrix material into the porosity of the first and second reinforcement, the depositing also providing bonding between the first and second reinforcements. Matrix material may be deposited by melt infiltration of silicon so that the matrix is silicon carbide or mixture of silicon and silicon carbide (col. 2-7). Steibel et al. to not disclose providing the composite turbine blade with a dovetail section by inserting an insert perform in the dovetail section."

The Examiner then brings in a secondary reference stating:

"JP 6-137103 teaches that a fiber reinforced composite turbine blade, such as of fiber strengthening ceramic (ceramic matrix composite), is made with a dovetail section using reinforced fiber which extends from the dovetail section to the lade part (Abstract and computer translation)."

The Examiner adds a third statement:

"The admitted prior art teaches that to manufacture thick dovetail sections of turbine engine components using ceramic matrix composites, perform inserts are used in the dovevail section to build up the thickness [0004]."

The Examiner then concludes:

"It would have been obvious to one of ordinary skill in the art to have modified the method of Steibel et al. for making a composite turbine blade by making the turbine blade with dovetail section, as taught by JP'103 as provided as part of a turbine blade and also made during the fabrication of a fiber reinforced composite blade. Providing the fabric plies (outer shell section perform) to extend from the blade part to a dovetail section to form both the blade and dovetail section of a turbine blade in one step of matrix deposition would have been obvious to one of ordinary skill in the art, as JP'103 teaches that the reinforcing fiber for a turbine blade extends from the blade to the dovetail section.

Providing an insert perform in the dovetail section would have been obvious to one of ordinary skill in the art, as the admitted prior art teaches that perform inserts are used in the dovetail section to build up the thickness. Providing the insert perform in the dovetail section as silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite perform having porosity), or silicon-silicon carbide composite perform having some porosity, would have been obvious to one of ordinary skill in the art to provide the insert perform in the dovetail section similar to that provided in the blade section to allow for deposition of matrix by silicon melt infiltration, as disclosed by Steibel et al

Further, by providing a second reinforcement of silicon carbide fabric plies for defining the surface shape of the blade and into which silicon can be deposited by met infiltration, an outer shell preform having at least some porosity is obviously provided."

Applicant's respectfully traverse the rejection of claims 17 and 18 under 35 U.S.C. 103(a).

The following principle of law applies to all Section 103 rejections. MPEP 2143.03 provides "To establish prima facie obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). All words in a claim must be considered in judging the patentability of that claim against the prior art. In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970)." [emphasis added] That is, to have any expectation of rejecting the claims over a single reference or a combination of references, each limitation must be taught somewhere in the applied prior art. If limitations are not found in any of the applied prior art, the rejection cannot stand. In this case, the applied prior art reference, applied individually, clearly do not arguably teach some limitations of the claims.

Steibel '550, as understood, is directed to a method of forming a composite article, such as a turbine vane, formed by preparing a porous first-region piece and then applying at least one second-region layer. Steibel '550 discloses wherein the first-region piece is rigidized prior to applying the at least one second-region layer. Steibel '550 further discloses at Figure 5 and supporting discussion wherein said process is used to form a turbine vane.

The Examiner then brings in a secondary reference to JP 6-137103 and a third reference by alleged admission, to try to cure deficiencies of the primary reference to incorporate a dovetail, and to bring into the dovetail an insert as claimed by Applicant.

Applicant asserts that the combination of references and admission do not render obvious Applicant's claimed invention. In particular, at [0004] of the pending Specification, Applicant stated:

"[0004] A number of techniques have been used in the past to manufacture thick dovetail sections of turbine engine components using both polymeric and ceramic matrix composites. These techniques include the use of insert plies and preform inserts in the dovetail section to

build up thicknesses. The local properties of the composite are typically optimized by selecting the appropriate ply stacking sequence. One of the main challenges in manufacturing turbine blades using composite materials is the building up of the thick dovetail section of such turbine blades. Due to the relatively brittle nature of the ceramic matrix composites (CMCs), particularly at low temperatures, and the unique processing step used to make these materials such as melt infiltration and chemical vapor infiltration, the concepts that have been used in the past for polymeric matrix composites (PMCs) are not directly useful here, since such concepts do not fully densify thicker portions of CMCs, which are required for turbine blade dovetail sections. High compressive strength is required in the centermost regions of the dovetail section of turbine blades. Such high compressive strength is not achieved when the thick dovetail section of CMC turbine blades is not fully densified. In addition, the material density in the dovetail section of CMC turbine blades is not predictable because of the level of densification that does occur is unpredictable. What is needed is a method that fully densifies thick dovetail sections of CMC turbine blades in a predictable manner to produce a CMC turbine blade having high temperature capability."

Applicant does not disagree that inserts, as disclosed in the prior art, have been used in building up thickness in dovetail sections. For example, dovetail inserts are disclosed in U.S. Pat. Nos. 4,040,770 and 3,752,600. In U.S. Pat. No. 4,040,770 inserts of dense homogeneous material such as titanium and stainless steel are disclosed. In U.S. Pat. No. 3,752,600 metallic inserts are disclosed. However, no inserts, as disclosed and limited by the claim language of this pending application have been disclosed by the prior art. In this application, as found in pending claim 17, the building of dovetail sections with the following limitations is claimed:

"providing a core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of a silicon carbide-silicon carbide composite preform having at least some porosity, a silicon-silicon carbide composite, the silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the core insert section and the outer shell preform into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the core insert section is positioned in the dovetail section of the turbine blade form; and filling remaining porosity in the turbine blade form with at least silicon using the silicon melt infiltration process, the filling also forming a bond between the core insert section and the outer shell preform."

The above limitations have not been taught nor obvious from the combined art. The combined art does not disclose the selection of material nor the bond formation of the core inserts as claimed.

The preforms of Steibel et al. '550 are used in forming a vane portion of a turbine component, and more particularly, are taught to form component parts wherein the performs are used in areas of hollow passageways or cooling channels. Additionally, the Applicant finds that the entire disclosure of Steibel et al. is directed to the vane section of the turbine blade and is completely silent as to the dovetail section of the blade. As discussed in Applicant's Specification at [0027], "The turbine blade 20 is mounted to a turbine disk (not shown) by a dovetail 24 that extends downwardly from the airfoil 22 and engages a slot of similar geometry of the turbine disk. Applicant similarly stated at [0040] that "The turbine blade 20 is mounted to a turbine disk (not shown) by a dovetail 24 that extends downwardly from an engages a slot on the turbine disk where it is secured in position." Steibel et al. '550 makes no reference to a dovetail section.

Thus, the teaching of Steibel et al. '550 does not teach or suggest the insert material and formation in the dovetail section as claimed. Furthermore, one of ordinary skill in the art, aware of the differences in desired characteristics between the vane or airfoil portion of the turbine blade and the dovetail portion of the turbine blade, and the differences in the operating conditions to which these different parts of the components would be exposed, would not find obvious the interchangeability of components, including inserts.

These deficiencies of Steibel et al. '550 are not be cured by the secondary references. At best, JP 6-137103 teaches that the reinforcing fibers of the turbine vane extend into the dovetail section. This fails to cure Steibel et al. '550 it's deficiencies by failing to provide a teaching that the performs would be made of these extended reinforcing fibers.

Furthermore, Applicant's admission as to inserts being known in the dovetail section, as found for example in the two U.S. patents discussed above, fails to cure the deficiencies of Steibel et al. The inserts of the prior art do not possess the claimed limitations as recited in the pending independent claims.

In summary, the Examiner has failed to show how the combination of references produce a dovetail section as claimed with limitations to

"providing a core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of a silicon carbide-silicon carbide composite preform having at least some porosity, a silicon-silicon carbide composite, the silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the core insert section and the outer shell preform into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the core insert section is positioned in the dovetail section of the turbine blade form; and filling remaining porosity in the turbine blade form with at least silicon using the silicon melt infiltration process, the filling also forming a bond between the core insert section and the outer shell preform."

The Examiner makes unsupported statements, as found in the Examiner's Response to Arguments, as follows:

"Steibel et al. '550 discloses that silicon carbide-silicon carbide composite performs having porosity and silicon-silicon carbide composite performs having some porosity are used as perform inserts to make ceramic matrix composite turbine blades. Thus the use of these types of inserts in also a dovetail section would have been obvious to one of ordinary skill in the art."

This unsupported statement, as discussed above, is nothing less than hindsight reconstruction and lacking in both support and motivation.

Applicant asks that the Examiner reconsider and withdraw this ground of rejection.

B. Steibel et al. 6,280,550 in view of JP 6-137103 and the admitted prior art and Steibel et al. 6,258,737.

The Examiner has rejected claims 12-20 under 35 U.S.C. 103(a) as obvious over Steibel et al. '550, in view of JP 6-137103 and the admitted prior art and Steibel et al. 6,258,737, hereinafter referred to as "Steibel '737"

Specifically, the Examiner stated that:

"Steibel et al. 6,280,550 discloses a method of making a composite turbine blade comprising: providing first reinforcement comprising an insert preform of silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite preform having porosity); optionally depositing matrix material to fill only a portion of the porosity of the insert preform (silicon-silicon carbide composite preform having some porosity); providing second reinforcement comprising silicon carbide fabric plies (preform); applying the silicon carbide fabric plies to contact the insert preform and define the surface shape of the blade; and depositing matrix material into the porosity of the first and second reinforcement, the depositing also providing bonding between the first and second reinforcements. Matrix material may be deposited by melt infiltration of silicon so that the matrix is silicon carbide or mixture of silicon and silicon carbide. As shown in Figure 7, the insert is provided in the dovetail section of the blade (col. 2-7). Steibel et al. do not specifically disclose providing the composite turbine blade with a dovetail section by inserting a insert preform in the dovetail section."

The Examiner added a secondary reference, further stating:

"JP 6-137103 teaches that a fiber reinforced composite turbine blade, such as of fiber strengthening ceramic (ceramic matrix composite), is made with a dovetail section using reinforcing fiber which extended from the dovetail section to the blade part (Abstract and computer translation)."

The Examiner then added a third reference through a purported admission of prior art, stating:

The admitted prior art teaches that to manufacture thick dovetail sections of turbine engine components using ceramic matrix composites, perform inserts are used in the dovetail section to build up the thickness [0004].

The Examiner then added a fourth reference, further stating:

"Steibel et al. '737 teaches that in making a silicon carbide composite by melt infiltration with silicon, the silicon carbide fiber fabric is impregnated with high char yield slurry to form a prepreg before melt infiltration. The use of a high char yielding resin improves increases burnout strength, produces a hard, tough preform and provides integrity to the preform structure during silicon melt infiltration. Steibel et al. further teach that before melt infiltration, the impregnated fabric (prepregged cloth) is either subjected to compression molding, bladder molding or autoclaving to form a preform for melt infiltration. Steibel et al. also teach that carbon of micrometer particle size provided in silicon carbide preforms to give different composite properties of structure (col. 5, line 50 - col. 6, line 11, col. 6, line 64 - col. 7, line 12)."

The Examiner then makes an obviousness statement, stating:

"It would have been obvious to one of ordinary skill in the art to have modified the method of Steibel et al. for making a composite turbine blade by making the turbine blade with a dovetail section, as taught by JP'103 as provided as part of a turbine blade and also made during the fabrication of a fiber reinforced composite blade. Providing the fabric plies (outer shell section preform) to extend from the blade part to a dovetail section to form both the blade and dovetail section of a turbine blade in one step of matrix deposition would have been obvious to one of ordinary skill in the art, as JP'103 teaches that the reinforcing fiber for a turbine blade extends from the blade to the dovetail section.

Providing an insert preform in the dovetail section would have been obvious to one of ordinary skill in the art, as the admitted prior art teaches that the perform inserts are used in the dovetail section to

build up the thickness. Providing the insert perform in the dovetail section as silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite perform having porosity), or silicon-silicon composite perform having some porosity, would have been obvious to one of ordinary skill in the art to provide the insert perform in the dovetail section similar to that provided in the blade section to allow for deposition of matrix by silicon melt infiltration, as disclosed by Stebel et al.

It would have been obvious to one of ordinary skill in the art to further modified the method of Steibel et al. for making a composite turbine blade by providing the second reinforcement as impregnated with high char yielding slurry (pregregged or a perform) before contacting the insert perform, as taught by Stebel et al. '737, as impregnated in silicon carbon fiber fabric before silicon melt infiltration to increase burn-out strength, produce a hard, tough perform and provide integrity during silicon melt infiltration."

The Examiner then further added:

"Autoclaving the assembly of second reinforcement prepreg and insert perform before silicon melt infiltration, as claimed in claim 12, would have been obvious to one of ordinary skill in the art, as taught by Steibel et al. '737, to aid in forming the prepreg into perform shape before melt infiltration. It would have been obvious to have autoclaved to help shape the prepegged plies into the surface shape of the blade.

Providing the silicon-silicon carbide insert perform with carbon microspheres, as claimed in claims 14 and 19, would have been obvious to one of ordinary skill in the art, as taught by Steibel et al. '737, as added to silicon carbide performs to give different composite properties of structure. The use of carbon microspheres in either of the insert to second reinforcement perform would have been obvious to one of ordinary skill in the art depending on desired composite properties of the insert or the surface of the composite turbine blade."

Applicants respectfully traverse the rejection of claims 12-20 under 35 U.S.C.
§ 103(a).

Amended independent claim 12 recites:

"providing a core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of silicon carbide-silicon carbide composite preform having at least some porosity, silicon-silicon carbide composite, silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the core insert section and the outer shell section into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the core insert section is positioned in the dovetail section of the turbine blade form;"

and independent claim 17 recites:

"providing a core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of a silicon carbide-silicon carbide composite preform having at least some porosity, a silicon-silicon carbide composite, the silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the core insert section and the outer shell preform into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the core insert section is positioned in the dovetail section of the turbine blade form;"

The Examiner has not shown that Steibel et al. '550 teaches, as discussed in detail above in the traversal of the rejection of claim 17 under 35 U.S.C. 103 in Section A, positioning a core insert section into the dovetail section. Figure 7 of Steibel et al. '550 provides no disclosure as to a dovetail section and is only concerned with the airfoil section of a turbine blade. Furthermore, this defect is not cured by the secondary references to JP 6-137103 and the admitted prior art as further discussed above in Section A.

The addition of a fourth reference to Steibel et al. '737 fails to correct the deficiencies of the prior art.

Steibel et al. '737 is directed to a method of forming a silicon carbide-containing perform. Steibel et al. '737 provides no teaching or suggestion to position a core insert section in the dovetail section of a turbine blade. Furthermore, the Examiner has not shown that Steibel et al. '737 provides any disclosure concerning the dovetail section in general. The explanation of the rejection fails to address this limitation in the claims.

Therefore, for the reasons given above, independent claims 12 and 17 are believed to be distinguishable from Stiebel et al. in view of JP 6-137103, the admitted prior art, and Steibel et al. '737. In addition, dependent claims 13-16 and 18-20 are believed to be allowable as depending from what is believed to be allowable dependent claims 12 and 17 for the reasons given above.

Applicant asks that the Examiner reconsider and withdraw this ground of rejection.

CONCLUSION

In view of the above, Applicants respectfully request reconsideration of the Application and withdrawal of the outstanding rejections. As a result of the amendments and remarks presented herein, Applicants respectfully submit that claims 17 and 18 are not rendered obvious by Stiebel et al. '550 in view of JP 6-137103 and the admitted prior art, and thus are in condition for allowance. In addition, Applicants respectfully submit that claims 12-20 are not rendered obvious by Steibel et al. '550 in view of JP 6-137103, the admitted prior art, and Steibel et al. '737. In addition, Applicants respectfully request reconsideration and withdraw of the objection of claims 12-16 for informalities, as Applicant has amended the claims to correct the antecedent language. As the claims are not anticipated or rendered obvious by the applied art, Applicants request allowance of claims 12-20 in a timely manner. Applicants submit that no new matter has been added by the amendments to the claims. If the Examiner believes that prosecution of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact the Applicants.

The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to Deposit Account No. 50-1059.

Respectfully submitted,

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